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PATENT SPECIFICATION (11) 1 321 897

DRAWINGS ATTACHED

1 321 897

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(19)

(54) VALVES

(71) We, THE GARRETT CORPORATION, a Corporation organised under the Laws of the State of California, United States of America, of 9851-9951 Sepulveda Boulevard, Los Angeles 90009, California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to valves, for example for incorporation in the control system for an aircraft environment's supply where it is necessary to regulate the pressure and temperature of the air supplied to passenger or other compartments of the aircraft.

According to the present invention, a valve includes a fluid passage, a valve element supported for movement within the passage between passage-open and passage-closed positions, a fluid pressure operated actuator connected to the valve element and arranged to move in at least one direction towards one of said positions, the fluid pressure to the actuator being capable of modulation by a bleed valve, a control member for the bleed valve being mechanically interconnected with the valve element and being set with respect to the bleed valve by predetermined movement of the valve element, the control member being responsive to variations in temperature of fluid adjacent the valve element to adjust the bleed valve and thereby modulate the fluid pressure applied to the actuator to vary the position of the valve element. The valve element is for example of the butterfly type, and the actuator serves to move it in a passage closing direction upon an application of pressure to the actuator. Conveniently a predetermined temperature change reduces the fluid pressure in the actuator to cause the valve element to move in a passage opening direction. The variations in temperature may be sensed by temperature responsive means having a bimetallic element supported in connection with the valve element and movable therewith when the valve element is moved to a closed position. The valve element may be provided with restricted openings to expose the bimetallic element to fluid supplied to the fluid passage when the valve element is in a closed position.

Where the valve element is of the butterfly type, the butterfly may have a hollow shaft supported for pivotal movement and the temperature responsive means comprises a bimetallic strip coiled into a tubular element disposed in the hollow butterfly shaft and secured at one point thereto. Specifically the hollow shaft is connected with the actuator by a crank arm and connecting rod, movement of the actuator being transmitted to said bimetallic tubular element by said butterfly shaft.

Arrangements of this type are capable of multiplying the relatively small force of the temperature responsive element to effect the operation of the butterfly valve element in accordance with temperature change in fluid flowing through the passage.

The invention may be carried into practice in various ways but one specific embodiment will now be described by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is an axial cross section of a butterfly valve assembly according to the invention;

Figure 2 is a sectional plan of the assembly of Figure 1, the plane of the section being indicated by the line II-II of Figure 1;

Figure 3 is a sectional side elevation through a portion of the valve assembly on the plane indicated by the line III-III of Figure 1;

[Price 25p]

Figure 4 is a front elevation of the butterfly element on a reduced scale; and

Figure 5 is a cross section of the butterfly element on the planes indicated by the line V-V of Figure 4.

The drawings show a valve assembly 10 which includes a butterfly valve 11 and an actuator 12.

The valve 11 has a body 13 which forms a section of a passage through which the fluid flow to be controlled passes. The body receives a butterfly valve element 14 which is movable between open and closed positions to control the flow of fluid through the passage. The body also includes a portion 15, providing a chamber 16 in which mechanism 17 for transferring movement from the actuator to the butterfly element 14 is mounted. The butterfly element has a hollow shaft 18 with sections mounted in bearings 20 in the body 13 to provide for pivotal movement of the butterfly element between open and closed positions.

The shaft 18 extends into the chamber 16 and is provided therein with a disk member having a crank arm 21 projecting from one side. This crank arm has a connecting rod 22 pivotally attached to one end 23, the opposite end of the connecting rod being secured to the centre portion of a diaphragm assembly 24 forming part of the actuator 12. This diaphragm assembly has its periphery clamped between flanges on complemental sections of an actuator housing 25.

The diaphragm assembly includes plates 26 and 27 to receive the central portion of the diaphragm and give support thereto. The plate 26 has a spring adapter 28 provided thereon to locate one end of a coil spring 30, the opposite end of which engages one wall of the actuator housing. The tendency of the spring 30 to expand moves the diaphragm assembly upwards to the position shown in Figure 2, this movement being transmitted through the connecting rod and crank arm to the butterfly shaft to dispose the butterfly element in the passage-open position shown in Figure 1. The butterfly may be moved to a closed position by supplying fluid under pressure to the outer end of the actuator casing 25. This fluid under pressure moves the diaphragm assembly in opposition to the force of the spring 30, such movement being transmitted by the connecting rod and crank arm to the butterfly shaft.

Fluid under pressure is supplied to the outer end of the casing through a passage including an inlet port 31, a plurality of drilled openings 32 formed in the wall of the casing as shown in Figure 2, and a tube 33 communicating with the drilled openings and the outer end of the actuator casing. Item 32A is a plugged opening.

Certain of the drilled holes 32 are provided with orifices 37 and 38 to restrict the flow of fluid through the inlet passage. In the form of the invention shown, a regulator 40 (see Figure 2) communicates with the passage between the orifices 37 and 38 to limit the fluid pressure in this region to a predetermined value. The regulator illustrated includes a valve plunger 41 which is urged into engagement with a seat 42 by a spring 43. Other pressure regulating devices may be employed with equal facility. A relief valve 39 is positioned on the other side of the orifice 38.

The flow of fluid is modulated by control mechanism including a nozzle opening 34 formed in a block 35 secured in the chamber 16. As shown in Figure 2, the block 35 is provided with drilled holes connecting the nozzle 34 with the drilled holes 32 in the body. The nozzle 34 is normally closed by a resilient flapper valve 36 secured to the block 35 and engaging the wall thereof surrounding the nozzle opening 34.

When the flapper valve 36 is engaged with the surface of the block 35 around the nozzle opening 34, full fluid pressure in the passage will be applied to the diaphragm assembly of the actuator and the butterfly element will be moved to a closed position. To reduce this pressure in accordance with the temperature increase in the passage in the body 13, the flapper valve 36 may be moved away from the nozzle opening 34 to permit fluid under pressure to escape, thus decreasing the force applied to the diaphragm assembly.

To effect the operation of the flapper valve 36 in this manner, a temperature responsive mechanism has been provided. This temperature responsive mechanism includes a torsional bimetallic element 44 disposed in the hollow shaft 18 of the butterfly valve. The element 44 is formed of a bimetallic strip helically wound and is secured at one end 44*a* (Figure 3) to the butterfly shaft and at the opposite end has a shaft extension 45 projecting therefrom. This extension is supported in bearings 46 which are in turn supported in the portion of the butterfly shaft disposed in the chamber 16. The outer end of the shaft extension 45 is provided with an arm 47 for engaging a prong 48 suitably secured to the flapper valve 36. When the butterfly valve is in the open position, the operating end of arm 47 will be disposed at a location remote from the prong 48, as shown in Figure 2. However, upon the application of fluid pressure to the actuator to move the butterfly to a closed position, the rotation of the butterfly shaft will move the operating end of the arm 47 towards the outer end of the prong 48. Fluid supplied to the passage in body 13 will be prevented from flowing there-

through by the closed butterfly. A small flow of fluid, however, may take place through openings 49 formed in the tubular shaft of the butterfly and such fluid will intimately engage the bimetallic element therein. When the temperature of the fluid increases, the element will respond by twisting, causing torque to be transmitted to the extension 45. Predetermined turning movement of this element will cause the arm 47 to engage the prong 48 and move the flapper valve 36 away from the nozzle 34. Fluid may then bleed from the outer end of the actuator casing, permitting the spring 30 to expand and transmit opening movement to the butterfly.

It will be obvious that additional increase in temperature of the fluid will cause a further opening movement of the butterfly, and vice versa. The circulation of fluid from the main passage around the bimetallic element, irrespective of the position of the butterfly element, is assured by forming the holes 49 in the butterfly element and its shaft and by providing the grooves 50 on the upstream side communicating with such holes. Thus, even though the butterfly element is almost fully open, fluid can flow along the groove and be deflected by the side walls of the holes 49 through the aligned openings in the disk and shaft.

When the supply of fluid under pressure to the control mechanism is interrupted, the spring 30 will move the diaphragm assembly towards the outer end of the actuator casing, causing the butterfly valve to move to an open position. This movement also withdraws the arm 47 from the vicinity of the prong 48, and the flapper valve 36 will close for a subsequent operation.

WHAT WE CLAIM IS:—

1. A valve including a fluid passage, a valve element supported for movement within the passage between passage-open and passage-closed positions, a fluid pressure operated actuator connected to the valve element and arranged to move in at least one direction towards one of said positions, the fluid pressure to the actuator being capable of modulation by a bleed valve, a control member for the bleed valve being mechanically interconnected with the valve element and being set with respect to the bleed valve by predetermined movement of the valve element, the control member being responsive to variations in temperature of fluid adjacent the valve element to adjust the bleed valve and thereby modulate the fluid pressure applied to the actuator to vary the position of the valve element.

2. A valve as claimed in Claim 1 in which the valve element is of the butterfly type, and the actuator serves to move it in a passage closing direction upon an application of pressure to the actuator.

3. A valve as claimed in Claim 2 in which a predetermined temperature change reduces the fluid pressure in the actuator to cause the valve element to move in a passage opening direction.

4. A valve as claimed in any one of the preceding claims in which variations in temperature are sensed by temperature responsive means having a bimetallic element supported in connection with the valve element and movable therewith when the valve element is moved to a closed position.

5. A valve as claimed in Claim 4 in which the valve element is provided with restricted openings to expose the bimetallic element to fluid supplied to the fluid passage when the valve element is in closed position.

6. A valve as claimed in any one of the preceding claims in which resilient means are provided to move the valve element in a direction opposite that in which it is moved by the actuator.

7. A valve as claimed in Claim 4 in which the butterfly has a hollow shaft supported for pivotal movement and the temperature responsive means comprises a bimetallic strip coiled into a tubular element disposed in the hollow butterfly shaft and secured at one point thereto.

8. A valve as claimed in Claim 7 in which the hollow shaft is connected with the actuator by a crank arm and connecting rod, movement of the actuator being transmitted to said bimetallic tubular element by said butterfly shaft.

9. A valve as claimed in Claim 8 in which the butterfly and hollow shaft are provided with openings constructed to facilitate the flow of fluid from the passage into engagement with the bimetallic tubular element in all positions of said butterfly.

10. A valve as claimed in any one of Claims 7 to 9 in which the bimetallic tubular element is secured at one end to the butterfly shaft and is provided at the other end with an arm adapted to engage and actuate said bleed valve upon predetermined movement of said bimetallic tubular element in response to temperature variations.

11. A butterfly valve assembly substantially as described herein with reference to the accompanying drawings.

KILBURN & STRODE,
Chartered Patent Agents,
Agents for the Applicants.

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1,321,897 COMPLETE SPECIFICATION
3 SHEETS

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SHEET 1

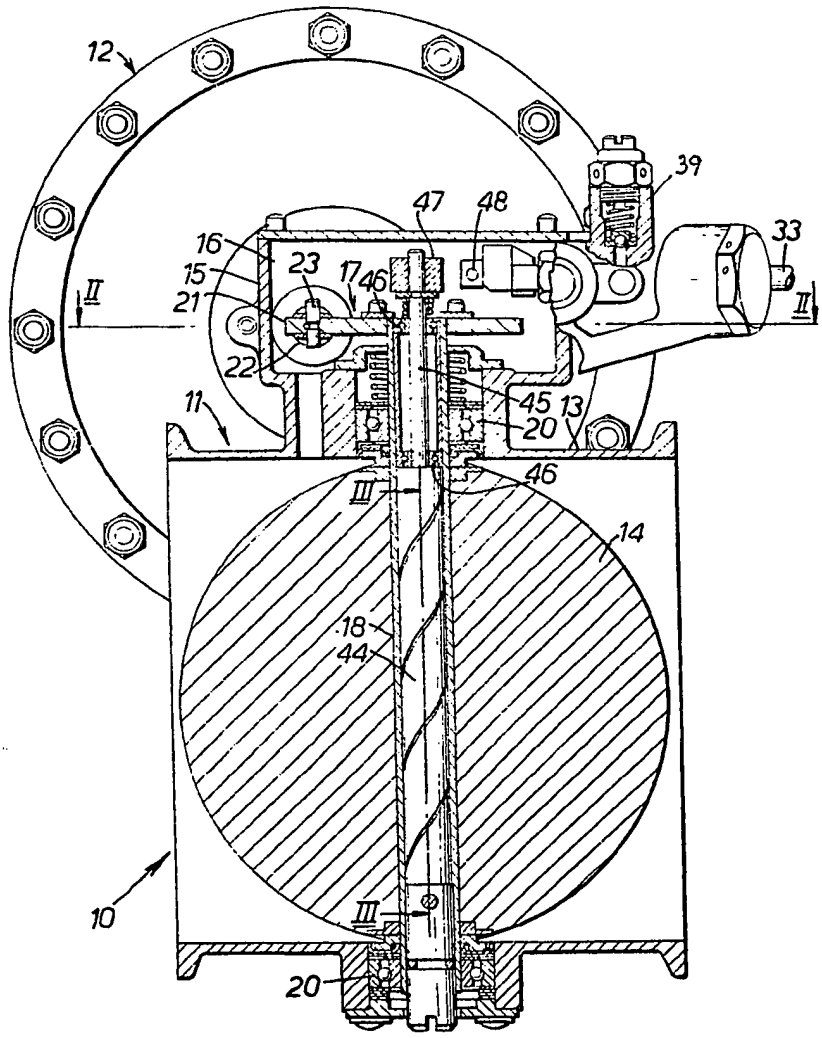

FIG. 1.

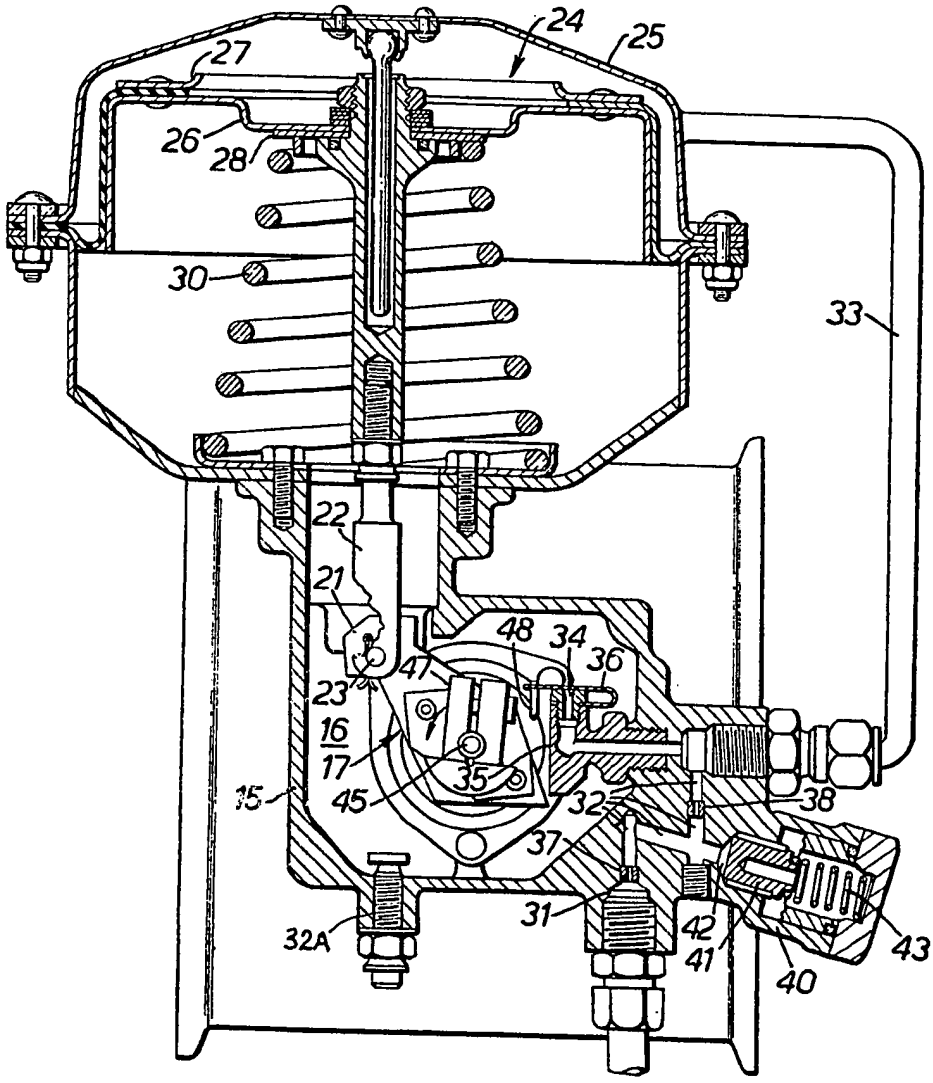

FIG. 2.

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3 SHEETS
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SHEET 3

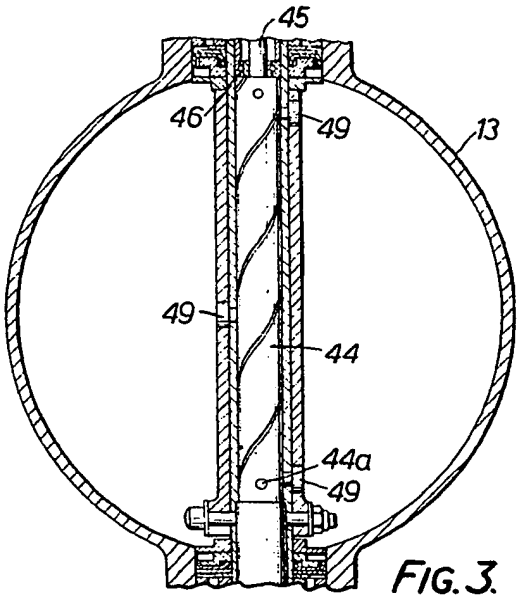

FIG. 3.

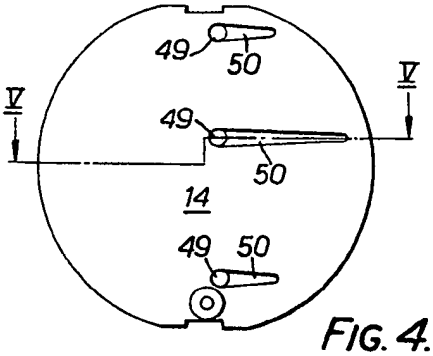

FIG. 4.

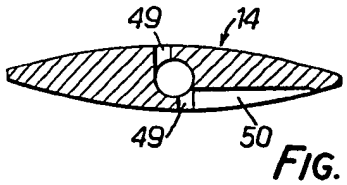

FIG. 5.